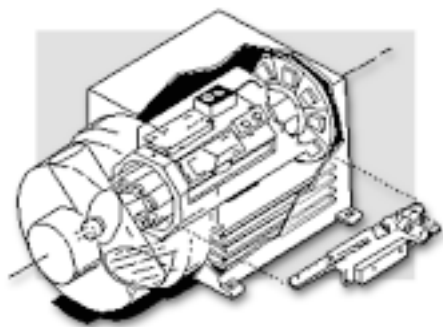


EOSP

Earth Observing Scanning Polarimeter



Key EOSP Facts

Heritage: Pioneer Venus CPP, Galileo PPR

Provides global aerosol distribution and cloud properties such as optical thickness and phase

Phase C/D start expected in 1999

Algorithm development to continue

Responsible Center: NASA/ Goddard Space Flight Center

EOSP will provide global maps of cloud and aerosol properties from retrievals of 12-channel radiance and polarization measurements in the visible and near-infrared (0.41 to 2.25 μm). The EOSP will scan its 10-km nadir instantaneous field-of-view from limb to limb in either the cross-track or along-track direction. Polarization and radiance measurements as a function of the specific scattering geometries will be used to retrieve aerosol and cloud properties including optical thickness, particle size, liquid/ice phase, and cloud-top pressure. A primary objective is the characterization of the global aerosol distribution, its spatial and temporal variability, and the corresponding impact on climate through direct radiative effects and indirect effects as cloud condensation nuclei. EOSP data will also be used to provide atmospheric corrections for clear-sky ocean and land observations and to investigate the potential for obtaining information on vegetation and land-surface characteristics.

By measuring the polarization as well as the radiance of the sunlight scattered by the atmosphere and surface, EOSP can exploit the much greater sensitivity of the linear polarization degree to the particular physical characteristics of the scattering particles or surface. For observations of cloudy regions, the relative contributions to the polarization by the scattering from the cloud particles as compared to the highly wavelength-dependent Rayleigh scattering by the atmosphere can be used to infer the cloud-top pressure. Because of the significant differences in the linear polarization corresponding to the spherical versus non-spherical particles with sizes on the order of those typical for clouds, EOSP observations will permit the identification of the cloud-top particle phase as liquid water or ice. The dependence of the polarization on particle size will allow its retrieval using algorithms that also utilize the multispectral radiance information.

For observed regions that are essentially cloud free, the objective is to retrieve aerosol characteristics. A crucial step in this retrieval process is the discrimination of truly cloud-free scenes from those that have optically thin, or subvisible clouds. The substantial differences in the polarization signatures for the cloud particles in contrast to the much smaller aerosol particles will be employed to distinguish these cases. While the optically thin conditions corresponding to cloud-free scenes present an advantage for polarization observations owing to the higher degree of polarization associated with less multiple scattering, there is the increased complexity of the contribution by the surface to the observed polarization and radiance. The separation of surface and aerosol contributions will rely upon techniques using both wavelength-dependent characteristics and sensitivity to observer zenith angle.

EOSP products will fall into three major categories: Atmospheric cloud properties, aerosol properties, and atmospheric correction radiances to be furnished to the other surface imagers on the EOS platform. EOSP data products will include the following:

- Cloud-top pressure, with 30-m vertical resolution and 40-km horizontal resolution
- Cloud particle phase at cloud top, with 100-km horizontal resolution
- Cloud particle size at cloud top, with 100-km horizontal resolution
- Cloud optical thickness, with 40-km horizontal resolution
- Aerosol optical thicknesses at an altitude range of 0 to 35 km, with 40-km horizontal resolution
- Atmospheric correction radiances covering the spectral region from 0.41 to 2.25 μm , with 40-km horizontal resolution.

Principal Investigator

Larry D. Travis

Larry D. Travis received a Ph.D. from Pennsylvania State University in 1971. He is currently the Associate Chief at the NASA Goddard Institute for Space Studies. His research interests include radiative transfer, single and multiple scattering theory, theoretical interpretation of planetary polarization, and satellite platform measurements of planetary polarization. Dr. Travis served as Principal Investigator for the Pioneer Venus Cloud Photopolarimeter Experiment and is a Co-Investigator for the Galileo Photopolarimeter Radiometer Experiment.

Co-Investigators

F. Gerald Brown - *Santa Barbara Remote Sensing*

Andrew Lacis - *NASA/Goddard Institute for Space Studies*

William B. Rossow - *NASA/Goddard Institute for Space Studies*

Edgar E. Russell - *Santa Barbara Remote Sensing*

References

Brown, F.G., and E.E. Russell, 1990: Earth Observing Scanning Polarimeter, Phase B Final Report. Contract #NAS5-30756, DM LB870016, Santa Barbara Research Center (December).

Mishchenko, M.I., and L.D. Travis, 1997: Satellite retrieval of aerosol properties over the ocean using polarization as well as intensity of reflected sunlight. *J. Geophys. Res.*, **102**, 16,989-17,013.

Mishchenko, M.I., and L.D. Travis, 1997: Satellite retrieval of aerosol properties over the ocean using measurements of reflected sunlight: Effect of instrumental errors and aerosol absorption. *J. Geophys. Res.*, **102**, 13,543-13,553.

EOSP Parameters

Simultaneous measurement of radiance and linear polarization degree in 12 spectral bands from 0.41 to 2.25 μm

Spectral bidirectional reflectance distribution function accurate to 5%

Polarization accurate to 0.2%

Swath: $\pm 65^\circ$ (limb-to-limb scan)

Spatial resolution: 10 km at nadir

Mass: 19 kg

Duty cycle: 100%

Power: 14 W (normal), 22 W (peak)

Data rate: 44 kbps (orbit average), 88 kbps (peak, daylight only)

Thermal control by: Heaters and radiators; 185 K radiator for SWIR detector cold focal plane

Thermal operating range: 0-40°C

FOV: $\pm 65^\circ$ limb to limb

Instrument IFOV: 14.2 mrad

Pointing requirements (platform+instrument, 3σ):

Control: 3,600 arcsec

Knowledge: 150 arcsec

Stability: 100 arcsec per 10 sec

Jitter: 100 arcsec per 10 sec

Physical size: 51 \times 26 \times 81 cm (stowed);
51 \times 56 \times 81 cm (deployed)

EOSP Data Products

<i>Product Name</i>	<i>Accuracy</i> Absolute :: Relative	<i>Temporal</i> Resolution	<i>Horizontal</i> Resolution :: Coverage	<i>Vertical</i> Resolution :: Coverage
Level-1B Polarization	0.2% :: 0.1%	1/day [d]	10-70 km :: Global	N/A :: N/A
Level-1B Radiance	5% :: 1%	1/day [d]	10-70 km :: Global	N/A :: N/A
Aerosol Optical Thickness	0.05 :: 10%	1/day [d]	40 km :: Global	Column:: Atmosphere
Cloud Product		1/day [d]	40-100 km :: Global	30 mb, Column :: Cloud